BRITISH COLUMBIA
MINISTRY OF FORESTS

Tree Farm Licence 53

Dunkley Lumber Ltd.

Rationale for Allowable Annual Cut (AAC) Determination

Effective June 1, 2003

Ken Baker
Deputy Chief Forester

Table of Contents

Page

Objective of this Document 1
Description of the TFL 1
History of the AAC 1
Critical Issue: mountain pine beetle epidemic 2
New AAC determination 2
Information sources used in the AAC determination 3
Role and limitations of the technical information used 4
Statutory framework 4
Guiding principles for AAC determinations 5
  Guiding principles with respect to First Nations 7
First Nations considerations 8
Consideration of Factors as Required by Section 8 of the *Forest Act* 9
  Mountain Pine Beetle Epidemic 9
    - the mountain pine beetle 9
    - mapping the infestation and its expansion 10
    - management strategy 12
Reasons for decision 13
Determination 15
Implementation 16
Appendix 1: Section 8 of the *Forest Act* 18
Appendix 2: Section 4 of the *Ministry of Forests Act* 20
Appendix 3: Extract from Unger, L. 1993. Mountain Pine Beetle. Forestry Canada, Forest Insect and Disease Survey, Forest Pest Leaflet No. 76, 7p 21
Appendix 4: Minister of Forests' letter of July 28, 1994 27
Appendix 5: Minister of Forests' memo of February 26, 1996 27

Objective of this Document

This document is intended to provide an accounting of the factors I have considered and the rationale I have employed in making my determination, under Section 8 of the *Forest Act* (the Act), of the allowable annual cut (AAC) for Tree Farm Licence (TFL) 53.

Description of the TFL

TFL 53, held by Dunkley Lumber Ltd. ('the licensee'), is 87 661 hectares in size located along Highway 97 between Prince George and Quesnel near the small communities of Hixon and Strathnaver.

The TFL area largely falls within the Sub-Boreal Spruce (SBS) biogeoclimatic zone, with approximately 10 percent of the gross area in the Engelmann Spruce Subalpine Fir (ESSF) zone. Forest stands within the SBS comprise primarily interior white spruce, lodgepole pine and coniferous mixed wood stands, with a small component of interior Douglas-fir.

The terrain is undulating with rolling hills and several small lakes and minor drainages. Productive forest comprises 81 318 hectares of the TFL and in deriving the assumed timber harvesting land base (THLB), 11 176 hectares of productive forest were excluded due to non-commercial brush, non-merchantable forest types, riparian reserve and riparian management zones, terrain instability, and the existing road network. The resultant current THLB is estimated to be 70 142 hectares, or 80 percent of the total TFL area. Timber harvested from TFL 53 is processed in the licensee's sawmill in Strathnaver. TFL 53 supplies approximately 30 percent of the total volume utilized by this mill.

History of the AAC

In 1987, Dunkley Lumber Ltd. applied for a tree farm licence upon surrender of its forest licence in the Prince George TSA. In its application Dunkley requested that the quota which had been committed to Dunkley from the Prince George TSA (167 380 cubic metres per year) be transferred to a tree farm licence tenure to secure a supply of timber for Dunkley's sawmill in Strathnaver. A land base was delineated that would support the Dunkley quota plus a Small Business Forest Enterprise Program (SBFEP) allocation. On May 30, 1989, the chief forester determined an AAC for TFL 53 of 187 630 cubic metres as proposed in Management Plan No. 1, and the TFL was issued on September 1, 1989. The AAC included 28 620 cubic metres to be allocated to the SBFEP.

On December 23, 1994, an AAC of 204 700 cubic metres was determined for TFL 53, which included the allocation of 28 620 cubic metres for the SBFEP. The 1994 determination included a partition of 4100 cubic metres per year to the residual balsam-leading stands (resulting from historic intermediate utilization (IU) logging) containing merchantable timber volumes of between 50 and 140 cubic metres per hectare.

On December 15, 1999, a new AAC of 239 500 cubic metres, an increase of approximately 17 percent from the previous AAC, was determined for TFL 53. In this

AAC the partition of 4100 cubic metres for residual balsam-leading stands was maintained and a new partition of 2000 cubic metres for aspen-coniferous stands was created. The AAC included 28 620 cubic metres for the SBFEP (now administered by British Columbia Timber Sales).

The *Forest Act* requires that AACs be re-determined within five years. Therefore a new determination for TFL 53 has been scheduled for late 2004. For the reasons described in this document, however, I have concluded that a change in the AAC is needed before then.

Critical Issue: mountain pine beetle epidemic

TFL 53 lies within a vast area in central British Columbia that is experiencing a mountain pine beetle (MPB) epidemic unprecedented in its severity and extent. In areas surrounding the TFL, the infestation has been expanding exponentially, both in terms of the area infested, and in terms of the volume of trees killed.

The beetle situation overwhelms all other factors in this determination. I have documented my considerations regarding management objectives for the control and salvage of the damage done by beetles under section 8(8)(e) of the *Forest Act: Abnormal infestations in and devastations of, and major salvage programs planned for, timber on the area.*

Although, I have reviewed all of the factors specified in Section 8 of the *Act*, and have given them due consideration, the only factors that will be discussed in detail in this rationale are First Nations considerations, and the implications of the bark beetle epidemic.

At present, the volume of timber on the THLB that meets current merchantability limits is approximately 10.3 million cubic metres, or about 77 percent of the total inventory on the THLB. Of the total inventory, 3.8 million cubic metres is lodgepole pine, of which 3.6 million cubic metres is found in pine leading stands. It is the pine volume that is seriously at risk to loss because of the rapidly escalating infestation by mountain pine beetles.

New AAC determination

Effective June 1, 2003, the new AAC for TFL 53 will be 500 000 cubic metres, an increase of 109 percent from the previous AAC. The purpose of this increase is to provide the licensee with sufficient AAC to mitigate timber losses due to the current MPB epidemic. My reasons for setting the new AAC at this level are explained in this document under *Reasons for decision.*

In the near-term, I expect the licensee to focus primarily on mitigating losses to the beetle infestation, which may well result in temporarily reducing the harvest of residual balsam-leading stands, and aspen-coniferous stands. Consequently, I am not continuing the previous partitions to those areas.

I expect the licensee to harvest a maximum of approximately 100 000 cubic metres per year from stands other than beetle infested lodgepole pine stands, as explained under *Reasons for decision.*

This AAC will remain in effect until a new AAC is determined, which must take place within five years of this determination. However, I have asked the licensee to continue gathering information and doing a new timber supply analysis so that I can make a new AAC determination in late 2004 as previously scheduled.

Information sources used in the AAC determination

Information considered in determining the AAC for TFL 53 includes the following:

- *Data Package and Analysis of a MPB Epidemic in Support of an AAC Uplift for TFL 53.* Submitted January 28, 2003 and accepted February 14, 2003.
- *Timber Supply Analysis Information Package: TFL 53*, Management Plan No. 3, Dunkley Lumber Ltd., accepted February 3, 1999;
- Existing stand yield tables for TFL 53, approved by BCFS Resources Inventory Branch, February 9, 1999;
- Managed stand yield tables and site index curves, approved by BCFS Research Branch, March 19, 1999;
- *Timber Supply Analysis Report: TFL 53*, Management Plan No. 3, Dunkley Lumber Ltd., accepted June 14, 1999;
- *Management Plan No. 3: TFL 53*, Dunkley Lumber Ltd., submitted June 30, 1999; approved December, 1999;
- *TFL 53, Twenty-Year Plan*, Dunkley Lumber Ltd., accepted June 30, 1999;
- *Rationale for AAC Determination for TFL 53*, BCFS Deputy Chief Forester, December 14, 1999;
- *Prince George Land and Resource Management Plan (LRMP)*, Province of British Columbia, March 1999;
- Summary of public input solicited by the licensee regarding the request for a temporary AAC uplift for salvage of beetle killed timber, March 4, 2003;
- Letter from the Minister of Forests to the Chief Forester, dated July 28, 1994, stating the Crown's economic and social objectives for the province;
- Memorandum from the Minister of Forests to the Chief Forester, dated February 26, 1996, stating the Crown's economic and social objectives for the province regarding visual resources;
- Letter from the Deputy Ministers of Forests, and Environment, Lands and Parks, dated August 25, 1997, conveying government's objectives regarding the achievement of acceptable impacts on timber supply from biodiversity management;
- Review of TFL 53 and operating conditions through on-site discussions between Dunkley Lumber Ltd. staff and the Deputy Chief Forester during January 28 – 29, 2003;

- Technical review and evaluation of current operating conditions through comprehensive discussions with BCFS staff, including the AAC determination meeting held in Victoria on April 16, 2003;
- *Forest Practices Code of British Columbia Act*, consolidated to June 1999;
- *Forest Practices Code of British Columbia Act Regulations and Amendments*, consolidated to June 1999;
- *Forest Practices Code of British Columbia Guidebooks*, British Columbia Forest Service (BCFS) and Ministry of Water, Land and Air Protection (MWLAP);
- *Landscape Unit Planning Guide*, BCFS and MWLAP, March 1999;
- *Forest and Range Practices Act*, consolidated to November 2002.

Role and limitations of the technical information used

Section 8 of the *Forest Act* requires the chief forester to consider biophysical as well as social and economic information in AAC determinations. A timber supply analysis, and the inventory and growth and yield data used as inputs to the analysis, typically form the major body of technical information used in AAC determinations. Timber supply analyses and associated inventory information are concerned primarily with biophysical factors—such as the rate of timber growth and definition of the land base considered available for timber harvesting—and with management practices.

However, the analytical techniques used to assess timber supply are necessarily simplifications of the real world. There is uncertainty about many of the factors used as inputs to timber supply analysis due in part to variations in physical, biological and social conditions, although ongoing science-based improvements in the understanding of ecological dynamics will help reduce some of this uncertainty.

Furthermore, technical analytical methods such as computer models cannot incorporate all of the social, cultural and economic factors that are relevant when making forest management decisions. Therefore, technical information and analysis do not necessarily provide complete answers or solutions to forest management problems such as AAC determinations. The information does, however, provide valuable insight into potential impacts of different resource-use assumptions and actions, and thus forms an important component of the information required to be considered in AAC determinations.

In determining the AAC for TFL 53, I have considered known limitations of the technical information provided, and I am satisfied that the information provides a suitable basis for my determination.

Statutory framework

Section 8 of the *Forest Act* requires the chief forester to consider particular factors in determining AACs for timber supply areas (TSAs) and TFLs. Section 8 is reproduced in full as Appendix 1.

In accordance with Section 23(3) of the *Interpretation Act*, the deputy chief forester is expressly authorized to carry out the functions of the chief forester, which include those required under Section 8 of the *Forest Act*.

The chief forester has expressed the importance of consistency of judgement in making AAC determinations. I also recognize the need for consistency of approach, and I am familiar with the guiding principles that the chief forester has employed in making AAC determinations. I find these principles to be reasonable and appropriate and I have adopted them as described below in making my AAC determination for TFL 53.

Guiding principles for AAC determinations

Rapid changes in social values and in our understanding and management of complex forest ecosystems mean that there is always some uncertainty in the information used in AAC determinations. When a large number of determinations are made for many forest management units over extended periods of time, administrative fairness requires a reasonable degree of consistency of approach in incorporating these changes and uncertainty. To make his approach in these matters explicit, the chief forester has compiled a set of guiding principles for AAC determinations. I have reviewed these principles and find them to be reasonable, and thus I have adopted and applied them as deputy chief forester in AAC determinations for TFLs. These principles are set out below. If in some specific circumstance I believe it is appropriate to deviate from these principles, I will provide a detailed reasoning in the considerations that follow.

Two important ways of dealing with uncertainty are:

(i) minimizing risk, in respect of which in making AAC determinations, I consider the uncertainty associated with the information before me, and attempt to assess the various potential current and future social, economic and environmental risks associated with a range of possible AACs; and

(ii) re-determining AACs frequently, to ensure they incorporate current information and knowledge, a principle that has been recognized in the legislated requirement to re-determine AACs every five years. The adoption of this principle is central to many of the guiding principles that follow.

In considering the various factors that Section 8 of the *Forest Act* requires the chief forester to take into account in determining AACs, I attempt to reflect as closely as possible operability and forest management factors that are a reasonable extrapolation of current practices. It is not appropriate to base my decision on unsupported speculation with respect either to factors that could work to increase the timber supply—such as optimistic assumptions about harvesting in unconventional areas, or using unconventional technology, that are not substantiated by demonstrated performance—or to factors that could work to reduce the timber supply, such as integrated resource management objectives beyond those articulated in current planning guidelines or the *Forest Practices Code of British Columbia Act* and its associated regulations (the Forest Practices Code).

The *Forest Practices Code of British Columbia Regulations* were approved by the Lieutenant Governor in Council on April 12, 1995, and released to the public at that time. The *Forest Practices Code of British Columbia Act* was brought into force on June 15, 1995.

Although the Forest Practices Code has been fully implemented since the end of the transition period on June 15, 1997, the timber supply implications of some of its provisions, such as those for landscape-level biodiversity, still remain uncertain, particularly when considered in combination with other factors. In each AAC determination the chief forester takes this uncertainty into account to the extent possible in the context of the best available information. In making my determination for TFL 53, as deputy chief forester, I have followed the same approach.

More recently, on November 21, 2002, government passed the *Forest and Range Practices Act*, which is expected to ultimately replace the *Forest Practices Code of British Columbia Act*. As the timber supply implications of this new Act and any pursuant regulations become clear and measurable, they will be accounted for in AAC determinations. Uncertainties will continue to be handled as they were under the previous legislative regime.

As British Columbia progresses toward completion of strategic land-use plans, the timber supply impacts associated with the land-use decisions resulting from the various planning processes are important to AAC determinations. Where specific protected areas have been designated by legislation or by order in council, these areas are no longer considered to be part of the timber harvesting land base or to contribute to the timber supply in AAC determinations.

Because the outcomes of planning processes are subject to significant uncertainty until formal approval by government, it has been and continues to be the position of the chief forester that in determining AACs it would be inappropriate to attempt to speculate on the timber supply impacts that will eventually result from land-use decisions that have not yet been taken by government. I consider this approach to be reasonable and appropriate. Like the chief forester, I will therefore not take into account the possible impacts of existing or anticipated recommendations made by such planning processes, nor attempt to anticipate any action the government could take in response to such recommendations.

Moreover, even where government has made a formal land-use decision, it may not always be possible to fully analyze and account for the consequent timber supply impact in a current AAC determination. In many cases, government's land-use decision must be followed by a number of detailed implementation decisions. For example, a land-use decision may require the establishment of resource management zones and resource management objectives and strategies for these zones. Until such implementation decisions are made, it would be impossible to fully assess the overall impacts of the land-use decision. Nevertheless, the legislated requirement for five-year AAC reviews will ensure that future determinations address ongoing plan implementation decisions.

A number of intensive silviculture activities have the potential to affect timber supply, particularly in the long term. As with all components of an AAC determination, like the

chief forester, I require sound evidence before accounting for the effects of intensive silviculture on possible timber supply. Nonetheless, I will consider information on the types and extent of planned and implemented practices as well as relevant scientific, empirical and analytical evidence on the likely magnitude and timing of any timber supply effects of intensive silviculture.

Some have suggested that, given the large uncertainties present with respect to much of the data in AAC determinations, any adjustments in AAC should wait until better data are available. I agree that some data are not complete, but this will always be true where information is constantly evolving and management issues are changing. Moreover, in the past waiting for improved data created the extensive delays that resulted in the urgency to re-determine many outdated AAC's between 1992 and 1996. In any case, the data and models available today are improved from those available in the past, and will undoubtedly provide for more reliable determinations.

Others have suggested that, in view of data uncertainties, the chief forester should immediately reduce some AAC's in the interest of caution. However, any AAC determination made by the chief forester or myself must be the result of applying our individual judgement to the available information, taking any uncertainties into account. Given the large impacts that AAC determinations can have on communities, no responsible AAC determination can be made solely on the basis of a response to uncertainty. Nevertheless, in making my determination, I have made allowances for risks that arise because of uncertainty.

Overall, in making this AAC determination, as the deputy chief forester, I am mindful of the mandate of the Ministry of Forests as set out in Section 4 of the *Ministry of Forests Act*, and of the chief forester's responsibilities under the *Forest Practices Code of British Columbia Act* and the *Forest Act.*

Guiding principles with respect to First Nations

With respect to First Nations' issues, I am aware of the Crown's legal obligations, particularly as clarified in judgements by the Supreme Court of Canada and the British Columbia Court of Appeal. The AAC that I have determined should not in any way be construed as limiting obligations under these decisions, and in this respect it should be noted that my determination does not prescribe a particular plan of harvesting activity within TFL 53.

The British Columbia Court of Appeal decided in March 2002 that the Crown has an obligation to consult with First Nations with respect to asserted rights and title in a manner proportional to the apparent strength of the claimed interests. As a matter of course, I consider any information brought forward by all parties respecting First Nations' interests. In particular I consider information related to actions taken to protect interests, including operational plans that describe forest practices designed to address First Nations' interests. In this context, I re-iterate that my AAC determination does not prescribe a particular plan of harvesting activity, nor does it involve allocation of the wood supply to any particular party.

Subsequent to a determination, if I become aware of information respecting First Nations' interests that would substantially alter my understanding of relevant circumstances, I may revisit my determination sooner than as required by the Forest Act.

First Nations considerations

The Red Bluff Band (Lhtako Dene Nation) and Lheidli T'enneh First Nation use portions of TFL 53 for traditional purposes. Aboriginal interests on the TFL include the continued ability to hunt, fish, and gather plants for food and medicinal purposes, and the maintenance of a cultural and spiritual link to the land. Such interests have been documented in a number of traditional use studies and in a cultural heritage overview prepared for the Northern Interior Forest Region.

The Lheidli T'enneh First Nation has lodged statements of intent with the British Columbia Treaty Commission that include the TFL 53 land base in its entirety. The Lheidli T'enneh First Nation is at the Agreement-in-Principle stage of treaty negotiations. The Red Bluff Band has not lodged a statement of intent with the British Columbia Treaty Commission.

With respect to their most recent timber supply analysis, Dunkley staff contacted Chief Barry Seymour of the Lheidli T'enneh First Nation by phone on March 4, 2003 and sent him a copy of the licensee's public discussion paper describing the beetle outbreak and various possible salvage scenarios. The First Nation representatives were invited to review the document and provide written comments related to how their aboriginal interests might be affected by my AAC determination. Further discussions were held with the Referrals Coordinator of the Band, Jane Calvert, who said on March 27, 2003 that if the increase in salvage was in response to the beetle outbreak, then the Band would not oppose the increase.

Dunkley staff contacted the Red Bluff Band by phone on March 10, 2003 and sent them a copy of the public discussion paper. A meeting was held on April 8, 2003 with Fiona Boucher, forestry contact for the Red Bluff Band, to discuss the beetle expansion on the TFL and the various salvage scenarios proposed by Dunkley. The Red Bluff Band acknowledged that the beetle outbreak was a concern for everyone.

I note that the licensee regularly sends referrals regarding proposed Forest Development Plans (FDP) and FDP amendments to both First Nations depending on where cut blocks are proposed within the TFL. In previous contact with BCFS staff, local First Nations have indicated that employment of band members and economic benefit from forestry activities are their priorities. I understand the licensee has tried to provide economic opportunities to local First Nations when such opportunities arise.

I believe that consultations between the licensee and First Nations related to operational planning offer a good opportunity for sharing information. With this information, harvesting operations can be located, designed and timed to protect habitat, riparian areas and food and plant sites as much as possible within the constraints presented by attempts to mitigate the impact of the mountain pine beetle epidemic. The information available to

ine suggests that harvesting can be compatible with continued traditional use of the land base.

At this time, the nature, scope, and geographical location of potential aboriginal rights and title within TFL 53 remain inconclusive. To the extent that further information on aboriginal interests becomes available during the term of the new AAC, I will consider it in the next AAC determination, scheduled for late 2004. I encourage continued consultation with First Nations on operational activities, as is normal practice in the TFL, to enable design and timing of forest operations to minimize and hopefully eliminate negative impacts on First Nations' interests.

As I have noted in my *Guiding principles with respect to First Nations*, the AAC that I determine should not in any way be construed as limiting the Crown's obligations as described in court decisions with respect to aboriginal rights and title. The AAC that I determine does not prescribe any particular plan of harvesting activity within TFL 53 by requiring any particular area to be harvested or not harvested.

As I make my AAC determination, I am mindful of the responsibility of other statutory decision-makers to administer the determined AAC in a manner consistent with other legislation and with relevant decisions of the courts respecting the interests of First Nations.

Consideration of Factors as Required by Section 8 of the *Forest Act*

Section 8 (8)

In determining an allowable annual cut under subsection (1) the chief forester, despite anything to the contrary in an agreement listed in section 12, must consider

(e) abnormal infestations in and devastations of, and major salvage programs planned for, timber on the area.

Mountain Pine Beetle Epidemic

- the mountain pine beetle

The mountain pine beetle (MPB), *Dendroctonus ponderosae* Hopkins (*Coleoptera*: *Scolytidae*) is widely considered to be the most damaging of all the insects that attack lodgepole pine in western Canada. The insect is a small, cylindrical-shaped bark beetle.

Generally, the mountain pine beetles fly during mid-late summer seeking mature - overmature lodgepole pine trees. Upon locating a suitable host, females bore through the bark and start construction of an egg gallery in the sapwood and inner bark near the base of the tree. If the tree is young and growing vigorously, it can flood the beetle out with resin. Lodgepole pine approximately 80 years old or older usually cannot produce enough resin to evict the beetle. If not evicted, the beetle emits a pheromone attractant that induces a mass attack that can overwhelm the host tree.

The beetle introduces fungi that produce blue stain in the sapwood of the tree. These fungi interrupt the flow of water to the crown of the tree reducing the production of resin. Brood over-winter as larvae and feed on the inner bark of the tree. Unless killed by very cold temperatures over winter, or removed from the site by harvesting, the brood will emerge as adults during the next growing season and attack neighbouring susceptible host trees.

More specifically, brood will be killed by early fall temperatures of -18° Celsius but can survive to -37° during winter. However, several days of winter temperatures below -27° will kill a large portion of the population. Once the maturing larvae have resumed feeding in the spring, they again become very susceptible to freezing temperatures. Since the impact of low temperatures is moderated by snow insulation, the snow pack can also be a critical factor to beetle survival.

It is a combination of the fungi retarding water flow and beetle larvae eating the inner bark, interrupting the flow of nutrients, that kills the tree during the second growing season after initial or 'green- attack'. The tree's foliage turns red in the late spring following attack. This is called 'red-attack'. In subsequent years the dead standing tree will loose its needles. This final stage is called 'grey-attack'.

More details of MPB's life cycle and devastating power in destroying forests are presented in Appendix 3 to this document, *Forest Insect and Disease Survey, Forest Pest Leaflet No. 76*, a Forestry Canada publication.

- mapping the infestation and its expansion

The method for identifying and describing the extent of the infestation on TFL 53 is a combination of an aerial survey sketch-mapping process and a ground survey. According to Dunkley, in late August when the pine trees that are infested with beetles have turned yellow (before they turn red), an aerial detection/mapping flight is initiated. Using a helicopter equipped with an onboard global positioning system and a moving map display, a technician maps the positions of infestation centres. This data is used to produce large-scale maps for the ground detection crews. In early September, when the beetle flight has slowed, two-person crews visit each infestation centre to collect detailed site information including the extent of the attack and the number of years since individual trees were attacked. These crews also lay out trails to existing or proposed roads so that treatment or salvage activities can be planned. Table 1 shows the results of ground surveys conducted by Dunkley over the past three years.

Table 1: Results of mountain pine beetle ground surveys conducted in TFL 53.

Year	# of sites surveyed	Total site volume (m^3)	Red-attacked volume (m^3)	Green-attacked volume (m^3)	# of red trees	#of green trees	Green:red ratio
2000	394	2,348	501	1,847	910	3,358	4:1
2001	1,594	15,699	4145	11,554	7,536	21,000	3:1
2002	2,160	80,817	5,648	75,169	10,269	136,670	13:1

The MPB infestation within the neighbouring Quesnel TSA and Prince George Forest District has increased exponentially since 1999. In the Quesnel TSA the total area mapped with 'red-attack' increased from 19 505 hectares in 1999 to 84 083 hectares in 2001 and 369 371 hectares in 2002. The pattern is similar in the Prince George Forest District; the total area mapped with 'red-attack' increased from 5 409 hectares in 1999 to 29 614 hectares in 2001 and 146 739 hectares in 2002.

The MPB infestation on TFL 53 has started to increase dramatically. If the current pattern of mild winters persists, Forest Service Region and District staff and Forest Practices Branch forest health specialists expect the MPB problem on TFL 53 to mirror the explosive situation in the neighbouring Quesnel TSA and the Prince George Forest District. Although Dunkley has made exemplary efforts to locate and remove beetle-infested trees on the TFL land base, it is very likely that the TFL area will be heavily attacked in the next several years by beetles migrating generally eastward from the surrounding TSAs.

Table 2 shows the recent history of the mountain pine beetle infestation in TFL 53 and Dunkley's estimation of future infestation rates if the entire current AAC were directed towards harvest of beetle-attacked trees.

Table 2. TFL 53 MPB Infestation Rate – Historic and Predicted

Year	MPB Volume (m3)			Sanitation Harvest Volume [4] (m3/year)	After Sanitation Beetle Expansion Rate [5]	Proportion of Total Pine Volume at Risk [6]	Rate of Attack [7]
	Surveyed Green Attack [1]	Missed Green Attack [2]	Total Pine Attacked After Sanitation [3]				
1999	0	501	501			0.0%	
2000	1,847	4,145	5,992	28,006	11.96	0.2%	
2001	11,554	5,648	17,202	27,002	2.87	0.5%	
2002	75,169	8,472 [a]	83,641	113,033	4.86	2.2%	
2003			158,205	260,000	5.00	4.2%	11%
2004			472,423	239,500	4.50	12.5%	19%
2005			1,177,768	239,500	3.00	31.1%	37%
2006			996,668	239,500	2.00	26.3%	33%
2007						n/a	
Total Pine Volume Salvaged (m^3) [8] 2003-2006							978,500
Total Pine Volume at Risk in pure and mixed stands (m^3) [9]							**3,783,563**
Current Available AAC (m^3 per year) [10]							239,500

Footnotes:

1. *"Surveyed Green-attack"* is historic information acquired through extensive beetle probes.

2. *"Missed Green-Attack"* is red-attack that appears the year following a sanitation program and is surveyed the following year.
    a. The value 8,472m^3 is an estimate based upon previous years. It was obtained by multiplying the missed attack in 2001 by a factor of 1.5.
3. *"Total Pine Attacked After Sanitation"* is the sum of surveyed green-attacked pine volume and the missed green-attacked pine volume. Numbers from 2003 forward are predicted using the previous years attack volume multiplied by the "After Sanitation Beetle Expansion Rate" and with the "Sanitation Harvest Volume" subtracted. (i.e. 2004:158,205 x 4.50 – 239,500 = 472,423).
4. *"Sanitation Harvest Volume"* is the extent of the salvage program Dunkley can carry out. Values shown are based upon the TFL's current AAC. Historic values include incidental healthy volume.
5. *"After Sanitation Beetle Expansion Rate"* is the ratio of the total volume attacked from one year to the next. The values from 2003 forward are estimates based upon professional extrapolation of historic population dynamics in and around the TFL.
6. *"Proportion of Total Pine Volume at Risk"* is "Total Pine Attacked After Sanitation" divided by the "Total Pine Volume at Risk". These numbers are the pine volume at risk after sanitation efforts. (i.e. 2004: 472,423 / 3,783,563 = 12.5 %).
7. *"Rate of Attack"* is the proportion of pine at risk that is infected by green attack each year. These numbers are used to transfer pine at risk analysis units to green-attack analysis units in the forest estate model. The proportion is calculated by (the sum of the Pine Attacked after Sanitation + the Sanitation Volume) divided by the Total Pine at Risk. (i.e. 2004: 472,423+239,500/ 3,783,563 = 18.82%)
8. *"Total Pine Salvaged"* is the sum of the annual Sanitation Volume from 2003 to 2006.
9. *"Total Pine at Risk"* was determined as the total pine volume in all natural stands in the THLB currently greater than 60 years of age.
10. *"Current Available AAC"* is the sum of Dunkley's AAC within the TFL (210,880m^3) plus the SBFEP AAC within the TFL (28,620m^3).
11. *Shaded cells* are estimates based upon a continuing expansion of the MPB population on the TFL without a catastrophic mortality event.

I accept that the recent data for TFL 53 and the survey data from the neighbouring TSA and Forest District represent the best available information regarding the MPB epidemic and its probable spread within the license. TFL 53 experienced a mild fall in 2002 and spring in 2003. Unless severe and prolonged cold temperatures occur next winter, or freezing temperatures occur next spring, I expect rapid expansion will continue into 2004, putting all lodgepole pine within the TFL at high risk of being killed.

- management strategy

The licensee proposes to continue its aggressive beetle control operations which have minimized the presence of 'red or grey attacked' trees in the TFL. 'Green attacked' stands identified via ground surveys will be given highest priority for harvesting along with adjacent older, high-risk lodgepole pine stands. Secondly, 'red-attacked' and 'grey-

attacked' timber will be logged. Next, blowdown will be salvaged to minimize the loss of merchantable timber. Finally mature spruce/fir/balsam stands will be harvested to fulfill market requirements and to control the endemic spruce bark beetle population.

'Green attack' is targeted first to remove MPB from the site before they can spread to neighbouring trees during the next growing season. 'Red and grey attack' are prioritized second to ensure dead trees are harvested while they are still sound and have some economic value. According to Forest Service District staff, the licensee has followed this strategy since the outbreak of this epidemic.

Dunkley has developed markets in Japan where it traditionally supplies large dimension spruce lumber. Maintaining that market requires the company to supply its sawmill with a steady volume of large logs, obtained in part from TFL 53 and in larger part from the open log market.

It is my explicit expectation that the licensee will utilize the AAC that I have determined in this rationale according to its MPB salvage and control strategy and that the spruce harvest on TFL 53 will be no more than about 100 000 cubic metres per year.

Reasons for decision

I have considered the information discussed throughout this document, and I have reasoned as follows.

On the TFL area, approximately 3.8 million cubic metres of mature lodgepole pine is subject to attack by mountain pine beetle unless the epidemic is halted by extremely cold winter weather, freezing spring-time temperatures, or some other unforeseen factor. It is now late May, and I believe that the epidemic will continue unabated for the remainder of 2003. To maximize the recovery of economic value from this resource, I have reasoned that infested trees, and susceptible pine in close proximity to those infested trees should be logged to the extent necessary to control the spread of beetles and to minimize losses of merchantable timber. In removing infested and susceptible pine trees, I recognize that it will often be necessary to log other species to minimize the risk of windthrow and for practical engineering reasons.

In its timber supply analysis, the licensee provided numerous forecasts of timber supply modelled at initial harvest levels ranging as high as 600 000 cubic metres. In each case it was assumed that the licensee would harvest 100 000 cubic meters per year of species other than pine. This non-pine harvesting would be aimed at minimizing losses to wind, insects, and disease in older spruce, Douglas-fir, and balsam stands, and at generating a supply of large-log furnish for part of the licensee's sawmill equipment.

Section 8 of the *Forest Act* requires me to consider "the nature, production capabilities and timber requirements of established and proposed timber processing facilities". Having visited the licensee's sawmill at Strathnaver, I am aware that it requires a substantial volume of large logs to achieve economically viable rates of production and to meet the licensee's on-going market commitments. I am also aware that the licensee has historically purchased a significant volume of large logs on the open market, and intends to continue doing so.

In determining the new AAC, and despite the need to focus on minimizing losses to the mountain pine beetle epidemic, I have concluded it is reasonable to provide for harvesting up to 100 000 cubic metres of timber from older spruce, Douglas-fir, and balsam stands on the TFL. At that level, the licensee will continue to look to the open market for a substantial portion of its large-log furnish.

The licensee provided three "Infestation Rate Scenarios" that estimated volumes to be harvested or lost to the beetles at harvesting rates of 400 000, 500 000, and 600 000 cubic metres annually. In each scenario, the licensee estimated the volume of infested trees, and assumed that a certain percentage of that volume would be harvested while the trees still contained the beetles and larvae. The percentage of identified-and-harvested trees was based on the licensee's recent assessment of the number of 'green-attack' trees missed despite its intensive inventory and harvesting efforts.

Based on an estimate of the volume of "missed" infested trees, each scenario forecast the expansion rate of the population of infested trees based on experience in recent years in adjacent timber supply areas. The expansion rate was estimated to be 5.0 in 2003 and 3.5 or 4.0 in 2004. The modelled rate varied according to the assumed number of "missed" trees, which, in the model, depends in turn on the AAC and consequent level of harvest.

I believe that the licensee's projections of how the beetle population is likely to expand are reasonable, given recent experience in the surrounding timber supply areas. I also accept as reasonable the way in which the licensee modelled the impacts of various rates of harvesting.

In setting a new AAC effective June 1, 2003, it is important to note that it will be in effect for the remaining seven months of 2003. Given the lower AAC for the first five months of the year, the pro-rated AAC for 2003 will be 392 232 cubic metres. Of that, the SBFEP is entitled to 28 620 cubic metres, leaving Dunkley with an entitlement of 363 612 cubic metres. Assuming that 100 000 cubic metres of species other than lodgepole pine are harvested in 2003, the AAC available to the licensee to be dedicated to harvesting pine in 2003 is 263 612 cubic metres. That figure will rise to 371 380 cubic metres in 2004.

The licensee's "Infestation Rate Scenarios" indicate that, if the AAC were set at 500 000 cubic metres, approximately 64 percent of the total pine inventory could be harvested by the end of 2008, after allowing for the above-noted harvest of other species. If the AAC were set at 600 000 cubic metres, the modelled projections indicate that approximately 77 percent of the pine inventory could be harvested by 2008.

The question then is whether the beetle population will expand so rapidly as to kill every pine tree over the next few years. No one knows the answer to that question. I have concluded that it nevertheless is prudent to expect a rapidly expanding infestation in the short term, and therefore it is prudent to increase the AAC to facilitate larger-scale control and salvage operations in the short term.

In deciding how much to raise the AAC, I note that legislation constrains the licensee to harvesting no more than 110 percent of the accumulated AAC in a five-year period, but no longer imposes a maximum in any given year. I note that the current five-year cut control period for TFL 53 ends in December, 2003. I am aware that the licensee expects to

harvest some 320 000 cubic metres in 2003, which would bring the total to about 1.130 million cubic metres during the period 1999 through 2003.

A new AAC of 500 000 cubic metres beginning June 1, 2003 will have the effect of creating an accumulated AAC entitlement of about 1.172 million cubic metres for the cut-control period that ends in 2003. Therefore, the actual amount harvested will have been virtually identical to the accumulated AAC, and there will be no "carry-forward" of a cut control debit into the next five-year cut control period.

As noted above, in setting the AAC at 500 000 cubic metres beginning June 1, 2003, the prorated AAC for the entire year will be 392 000 cubic metres. I note that the licensee will be legally entitled to harvest more than that in 2003, and more than the AAC of 500 000 cubic metres in 2004 if necessary.[1]

I believe that a new AAC of 500 000 cubic metres for the remainder of 2003 and for all of 2004 will adequately facilitate beetle control and salvage operations over the coming two years. As mentioned above, I have asked the licensee to continue assembling information related to all factors prescribed by Section 8 of the *Forest Act* so that I can make a new determination near the end of 2004. At that time, I will be able to again assess the nature of the beetle problem, and adjust the AAC as necessary.

It is clear that an accelerated rate of harvesting will be detrimental to longer-term timber supply. The impact can be estimated using one of several harvest flow scenarios provided by the licensee. The licensee modelled a harvest flow of 500 000 cubic metres per year over the first five years, followed by 239 500 cubic metres during the second five years. The modelled timber supply drops to 185 000 cubic metres from the second through sixth decades, and then increases as second-growth timber becomes available.

Clearly an AAC of 500 000 cubic metres per year will significantly impact timber supply within perhaps ten years. However, I have concluded that if infested pine stands are not harvested, based on my current understanding of the epidemic, the timber will likely be lost to the MPB in any case.

Determination

I have considered and reviewed all the factors documented above, including the risks and uncertainties of the information provided. It is my determination that an AAC of 500 000 cubic metres is necessary and appropriate for TFL 53 in the immediate future. This represents an increase of 109 percent from the current AAC.

In the 1999 AAC determination, the Deputy Chief Forester attributed certain proportions of the AAC to residual balsam-leading stands and to aspen-coniferous stands. I am aware that Dunkley has, since then, harvested virtually the full portions of the AAC attributed to those stands. In the near term, however, I expect the licensee to reduce harvesting of those

---

[1] I am aware that legislation passed in March, 2003 gave the Province authority to take back 20 percent of the licensee's AAC to the extent it exceeded 200 000 cubic metres at that time. I understand that the Province is therefore expected to take back approximately 2 300 cubic metres of the AAC on TFL 53. I consider this to be not significant in this determination.

stands in favour of harvesting beetle-infested lodgepole pine stands. As a result, I do not specify any partition of the AAC to residual balsam leading stands, or to aspen-coniferous stands.

This determination is effective June 1, 2003 and will remain in effect until a new AAC is determined. Section 8 of the *Forest Act* does not require a new AAC determination until five years from this determination, unless that date is formally postponed in the meantime under authority of Section 8. However, I intend to make a new determination in late 2004, as previously scheduled. At that time I will re-examine the state of the bark beetle infestation, as well as all other factors specified in Section 8.

Implementation

I have significantly increased the AAC for TFL 53 for only one reason, and that is to facilitate harvesting of timber that would otherwise be lost to the mountain pine beetle epidemic. I am aware that significantly accelerated harvesting over the next few years will almost certainly lead to a reduced AAC for subsequent years. I am therefore assuming that the licensee will focus its harvesting as much as possible on timber that would otherwise be lost to the beetles.

I believe the licensee has made exemplary efforts to control the beetle population to date. I am relying on it to continue to operate according to its mountain pine beetle salvage and control strategy referred to earlier under *' management strategy'*. This means that first priority should be given to removing 'green-attack' lodgepole pine identified through ground surveys. Second priority should be given to harvesting 'red-attack' and 'grey-attack" lodgepole pine. Because cutblock boundaries will be designed to reflect engineering realities and to minimize the risk of blowdown, I recognize that minor amounts of other species will be harvested as well. The new AAC is also predicated on my assumption that Dunkley will harvest no more than 100 000 cubic metres per year from stands other than high-risk, lodgepole pine leading stands.

I request that Forest District staff continue to track the severity of the beetle epidemic on TFL 53 and let me know if harvesting priorities are not substantially in accordance with the above priorities.

Because the *Forest Act* no longer requires any licensee to harvest a minimum portion of its AAC in any given period, I encourage the licensee to not harvest its full AAC entitlement unless that is necessary to control the bark beetle infestation and avoid losses of merchantable timber.

Finally, I ask the licensee to let me know if it finds at any time that the AAC of 500 000 cubic metres is no longer needed to minimize losses to the mountain pine beetle epidemic.

Ken Baker

Ken Baker
Deputy Chief Forester

May 30, 2003

Appendix 1: Section 8 of the *Forest Act*

Section 8 of the *Forest Act*, Revised Statutes of British Columbia 1996, reads as follows:

Allowable annual cut

8. (1) The chief forester must determine an allowable annual cut at least once every 5 years after the date of the last determination, for

(a) the Crown land in each timber supply area, excluding tree farm licence areas, community forest areas and woodlot licence areas, and

(b) each tree farm licence area.

(2) If the minister

(a) makes an order under section 7 (b) respecting a timber supply area, or

(b) amends or enters into a tree farm licence to accomplish the result set out under section 39 (1) (a) to (d),

the chief forester must make an allowable annual cut determination under subsection (1) for the timber supply area or tree farm licence area

(c) within 5 years after the order under paragraph (a) or the amendment or entering into under paragraph (b), and

(d) after the determination under paragraph (c), at least once every 5 years after the date of the last determination.

(3) If

(a) the allowable annual cut for the tree farm licence area is reduced under section 9 (3), and

(b) the chief forester subsequently determines, under subsection (1) of this section, the allowable annual cut for the tree farm licence area,

the chief forester must determine an allowable annual cut at least once every 5 years from the date the allowable annual cut under subsection (1) of this section is effective under section 9 (6).

(3.1) If, in respect of the allowable annual cut for a timber supply area or tree farm licence area, the chief forester considers that the allowable annual cut that was determined under subsection (1) is not likely to be changed significantly with a new determination, then, despite subsections (1) to (3), the chief forester

(a) by written order may postpone the next determination under subsection (1) to a date that is up to 10 years after the date of the relevant last determination, and

(b) must give written reasons for the postponement.

(3.2) If the chief forester, having made an order under subsection (3.1), considers that because of changed circumstances the allowable annual cut that was determined under subsection (1) for a timber supply area or tree farm licence area is likely to be changed significantly with a new determination, he or she

(a) by written order may rescind the order made under subsection (3.1) and set an earlier date for the next determination under subsection (1), and

(b) must give written reasons for setting the earlier date.

(4) If the allowable annual cut for the tree farm licence area is reduced under section 9 (3), the chief forester is not required to make the determination under subsection (1) of this section at the times set out in subsection (1) or (2) (c) or (d), but must make that determination within one year after the chief forester determines that the holder is in compliance with section 9 (2).

(5) In determining an allowable annual cut under subsection (1) the chief forester may specify portions of the allowable annual cut attributable to

(a) different types of timber and terrain in different parts of Crown land within a timber supply area or tree farm licence area, and

(b) different types of timber and terrain in different parts of private land within a tree farm licence area,

(c) [Repealed 1999-10-1.]

(6) The regional manager or district manager must determine an allowable annual cut for each woodlot licence area, according to the licence.

(7) The regional manager or the regional manager's designate must determine a rate of timber harvesting for each community forest agreement area, in accordance with

(a) the community forest agreement, and

(b) any directions of the chief forester.

(8) In determining an allowable annual cut under subsection (1) the chief forester, despite anything to the contrary in an agreement listed in section 12, must consider

(a) the rate of timber production that may be sustained on the area, taking into account

(i) the composition of the forest and its expected rate of growth on the area,

(ii) the expected time that it will take the forest to become re-established on the area following denudation,

(iii) silviculture treatments to be applied to the area,

(iv) the standard of timber utilization and the allowance for decay, waste and breakage expected to be applied with respect to timber harvesting on the area,

(v) the constraints on the amount of timber produced from the area that reasonably can be expected by use of the area for purposes other than timber production, and

(vi) any other information that, in the chief forester's opinion, relates to the capability of the area to produce timber,

(b) the short and long term implications to British Columbia of alternative rates of timber harvesting from the area,

(c) the nature, production capabilities and timber requirements of established and proposed timber processing facilities,

(d) the economic and social objectives of the government, as expressed by the minister, for the area, for the general region and for British Columbia, and

(e) abnormal infestations in and devastations of, and major salvage programs planned for, timber on the area.

1998-29-2; 1999-10-1; 2000-6-2; 2002-25-21.

Appendix 2: Section 4 of the *Ministry of Forests Act*

Section 4 of the *Ministry of Forests Act* (consolidated 1988) reads as follows:

Purposes and functions of ministry

4. The purposes and functions of the ministry are, under the direction of the minister, to

(a) encourage maximum productivity of the forest and range resources in British Columbia;

(b) manage, protect and conserve the forest and range resources of the government, having regard to the immediate and long term economic and social benefits they may confer on British Columbia;

(c) plan the use of the forest and range resources of the government, so that the production of timber and forage, the harvesting of timber, the grazing of livestock and the realization of fisheries, wildlife, water, outdoor recreation and other natural resource values are co-ordinated and integrated, in consultation and co-operation with other ministries and agencies of the government and with the private sector;

(d) encourage a vigorous, efficient and world competitive timber processing industry in British Columbia; and

(e) assert the financial interest of the government in its forest and range resources in a systematic and equitable manner.

Appendix 3: Extract from Unger, L. 1993. Mountain Pine Beetle. Forestry Canada, Forest Insect and Disease Survey, Forest Pest Leaflet No. 76, 7p

Introduction

The mountain pine beetle, *Dendroctonus ponderosa*, a native pest, is the most serious insect enemy of mature pines in western Canada. In British Columbia, major outbreaks occurred in all areas with a significant pine component, except for the northern quarter of the province. Since the first recorded infestations in 1913, in the Okanagan and Merritt areas, major infestations have occurred in Kootenay National Park and the Chilcotin Plateau in the 1930s, on Vancouver Island during the 1940-50s, near Takla and Babine lakes in the 1950s, and through much of the southern interior, Chilcotin Plateau and the Skeena and Nass river areas in the late 1970s and 1980s. Well over 500 million trees were killed by the mountain pine beetle during the past 80 years.

Outbreaks generally last 8-10 years and severely deplete the pine component of forest stands; trees with a diameter greater than 25 cm are particularly susceptible. Extensive mountain pine beetle infestations hasten forest succession, change the age and diameter distribution of the pine components of the forest, and reduce aesthetic values. Infestations can also cause marketing and operational problems and environmental concerns when large volumes of dead pine are harvested either for control or salvage purposes.

Large reserves of mature pine forest are always at risk in areas climatically favorable for the beetle. Good access to susceptible forests is needed so that preventative measures can be taken and so that infested stands can be quickly treated.

Hosts

The mountain pine beetle is distributed throughout British Columbia north to 56° latitude. Infestations have been recorded from sea level to the highest elevations where the host species grow. Native hosts include lodgepole pine (*Pinus contorta*), ponderosa pine (*Pinus ponderosae*), whitebark pine (*Pinus albicaulis*), and limber pine (*Pinus flexilis*). Some exotic pines may also be attacked. Occasionally non-host trees such as Engelmann spruce (*Picea engelmannii*) are attacked, but beetle populations do not persist in these occasional hosts.

Description and Life History

Adults are cylindrical, 3.7 to 7.5 mm long; teneral adults are light creamy-tan in color, changing to black when mature.

Eggs are pearly white, about 1 mm in size, and are laid singly in niches on both sides of the parent gallery.

Larvae are white legless grubs with red-brown heads, about 5 mm long in the fourth (final) instar.

Pupae are white at first, changing to light brown, about 5 mm long, with the external characteristics of the adult beetle visible.

The life cycle of the mountain pine beetle varies considerably. The normal cycle takes one year to complete; however, during warmer than average summers, parent adults may re-emerge and establish a second brood in the same year. Conversely, in cooler summers or at higher elevations, broods may require two years to mature. These variations in the life cycle may result in rapid increases in population levels, or conversely, sharp population decreases.

Beetle flights normally occur throughout July and into August, and generally peak in late July. Upon locating a suitable host, females bore through the bark to the phloem and cambium region, and start construction of the egg gallery, usually on the lower 5 m of the bole. The first females that attack a tree emit an aggregating pheromone which attracts mainly males. The males in turn emit pheromones attracting additional females. This leads to a mass attack which overcomes the tree's resistance. The egg galleries are usually about 30 cm long but occasionally they may reach 90 cm. They extend upward parallel to the grain and usually score both bark and sapwood. Eggs are laid in individual niches 0.5 cm apart along both sides of the gallery, and are tightly packed with frass. Eggs generally hatch in 10-14 days. Larvae feed on the phloem in individual mines extending, under uncrowded conditions, about 13 cm at right angles to the egg gallery. Broods overwinter mainly as larvae. Larval development is completed in early summer of the following year. When larvae mature, they excavate an oval chamber in which they turn into pupae. Following a short pupation period, pupae become adults. Newly formed adults, called teneral adults, spend a brief period feeding under the bark before the mature adults emerge by boring through the bark and fly to living trees to commence another cycle.

Fungi, yeasts, bacteria and other microorganisms associated with the beetle are carried by them into the tree. Some of these microorganisms are pathogenic to the tree or the bark beetle, while others are beneficial to the beetle. Fungi, which are commonly introduced by the beetle and produce blue stain in the sapwood, commence growth in the phloem and xylem soon after the beetles start their galleries. As the fungi become established they interrupt the flow of water to the crown and reduce the tree's pitch flow, which is its main defense mechanism against beetle attack. Successfully established bluestain fungi will also retain moisture in the sapwood and prevent excessive dehydration of the phloem, which is essential for brood survival. The combined action of the beetle and fungi kills the tree. Teneral adults need to feed on fungal fruiting bodies to mature, and specialized mouth parts of the beetle ensure that emerging beetles carry fungi to living trees.

Damage and Detection

Infested trees can be detected through crown and external symptoms, but the mountain pine beetle can only be positively identified (and the success of an attack can only be positively determined) by looking under the bark.

External evidence of beetle infestation on the bole usually consists of (i) pitch tubes on the stem where beetles have entered the tree, and (ii) boring dust at the base of the tree.

The color of the pitch tube often indicates the success or failure of the beetle attack. Scattered pitch tubes that are whitish in color indicate that the tree has repelled or killed the beetle by pitch exudation. In contrast, numerous reddish brown pitch tubes usually indicate that the attack has succeeded. However, pitch tubes remain pliable for several years, so soft pitch tubes do not necessarily mean that a tree is currently under attack. Pitch exudation may not occur during periods of drought or when trees are stressed due to root rot or other reasons. However, trees that have been recently and successfully infested will have dry boring dust in bark crevices and at the base of the tree. The boring dust is produced only during the initial stage of gallery construction and, depending on weather conditions, it may rapidly become inconspicuous. Woodpecker activity will often be greatly increased in infested areas, and woodpeckers will leave numerous pecking holes and may remove sections of the bark.

Characteristic symptoms under the bark include a vertical parent gallery with a slight J-like hook at the bottom and evenly spaced larval galleries extending at right angles from the parent gallery. Galleries are tightly packed with sawdust. The phloem will be dried out and brownish, and the sapwood will usually be stained a bluish color due to the fungi associated with the beetle.

Tree foliage begins to dry out as soon as the conduction of water up the tree is interrupted. As a result, the color of the foliage on infested trees gradually changes from bright to dull green. This early symptom in the lower crown will often become visible 2-3 months after attack. However, more distinct color changes occur during the onset of the growing season the spring following attack. Most lodgepole pine change from yellowish green to an orangey red by July and rusty brown by late summer. At this time most of the beetles will have left the tree. Other tree species display varying color patterns: ponderosa pine seldom turns red but develops more of a straw color, while white pine tends to become bright red. With time, retained foliage color becomes more dull, and most of the foliage drops in 2-3 years; this will vary from species to species and with weather conditions. These rapid and distinct color changes are used to schedule aerial mapping of recently attacked trees.

Beetles Associated with Mountain Pine Beetle

A number of secondary beetles are associated with mountain pine beetle and at times these secondary beetles make diagnosis of the causal agent of tree mortality difficult. Secondary bark beetles generally do not successfully establish in healthy, vigorous trees.

Several engraver beetles (*Ips pini, I. latidens* and *I. mexicanus*) attack fresh windfelled trees, logging residue, and uninfested portions of the boles of trees killed by mountain pine beetle, as well as trees of low vigor caused by root rots, stem diseases, defoliation, etc. Occasionally, however, they may become destructive in apparently healthy trees, but infestations are usually short. Since a portion of the population overwinters in the duff, extreme cold winter temperatures, which can devastate mountain pine beetle population, are much less destructive to the Ips beetles. As a result, these engraver beetles, which increased along with the mountain pine beetle population, may continue at epidemic numbers for 1 or 2 years.

Ambrosia beetles (*Trypodendron spp.* and *Gnathotrichus spp.*) are wood or pinhole borers that infest recently killed trees, fresh slash, and downed material. Infestation by these beetles can be recognized by the small piles of white boring dust surrounding the points of entry into the wood or around the lower portion of the stem.

The red turpentine beetle (*Dendroctonus valens*) bores under bark near the root crown and produces large reddish brown pitch tubes around the base of the bole. This is the largest of the *Dendroctonus* species: larvae are up to 12 mm long, and the reddish coloured adults generally are between 5 and 9 mm.

The lodgepole pine beetle (*Dendroctonus murrayanae*) attacks the lower metre of the stem forming an irregular vertical gallery with eggs laid in groups of 20-50 along both sides of the gallery. Larvae feed gregariously. Larvae and the reddish brown adults are only slightly smaller than the same stages of the mountain pine beetle.

Sour sap bark beetles (*Hylurgops* and *Hylastes spp.*) usually attack the stem near and below duff level. Adults are black or reddish, but tend to be shorter (3-6 mm) and more slender than mountain pine beetle.

Management

Prevention

The first step in prevention of mountain pine beetle outbreaks is to prioritize stands for preventive maintenance. To this end, risk and susceptibility rating systems have been developed combining the stand parameters associated with beetle infestations and the beetle pressure on a stand. Susceptibility increases in stands (i) with trees over 60 years of age (moderate susceptibility) and with trees over 80 years of age (high susceptibility), (ii) with trees over 25 cm in diameter, (iii)

with a high pine component, (iv) with a density between 750 and 1500 trees/ha, and (v) at lower altitudes and latitudes. The risk of an infestation developing within a stand is based on its distance to the nearest infestation and its level of current attack. For example, stands within 3 km of an active infestation and with more than 100 trees already attacked would be considered at risk. Risk factors can change dramatically within a year, while stand susceptibility changes gradually over a number of years.

Silvicultural treatments which help to reduce stand susceptibility include (i) reducing stand density to below 500 trees/ha, (ii) establishing an age and tree size mosaic within a stand or drainage, (iii) implementing a shorter rotation period, and (iv) establishing a species mix within a stand. The effectiveness of these measures may be reduced considerably in the presence of high beetle pressure, however.

Aerial surveillance,especially of moderate to high risk stands, will detect the initial phases of beetle invasion and allow for the early implementation of effective control measures.

Ground surveys should be conducted when pockets of discolored trees first appear in a stand to verify the causal agent and the status of the brood.

Applied Control

A variety of applied controls can be utilized, depending upon the extent of the beetle problem. In conjunction with controls, synthetic aggregating pheromones can be used effectively to concentrate beetle attack. This greatly improves the efficiency in locating newly attacked trees for follow-up treatment actions, or for containing most of an attack within a given harvesting area. Under specific conditions, mass trapping of beetles may prevent small local beetle populations from increasing or it may even reduce these populations to endemic levels. However, the effect of trapping becomes negligible when the beetle populations reach epidemic proportions.

During the initial phases of an infestation when only small infestation pockets are present, individual trees containing beetle brood can be treated by felling and burning, applying an appropriate silvicide to infested trees within 24 days of attack, application of a registered insecticide to the bole of infested trees just prior to beetle emergence, and the use of pheromone-baited, lethal (insecticide-treated) trap trees. Permits are required for such work in B.C. forests.

At intermediate infestation levels (up to about 100 trees per patch), small-patch logging can be used if good access is in place, and if beetle attack is concentrated naturally or through the use of pheromone baits. Beyond the intermediate stage, and when infestations exceed 10 ha, control becomes increasingly more difficult. In larger infestations the rate and range of beetle dispersion increases and any effective control program will require very extensive ground surveys to locate the green, newly attacked trees. Consequently, the only practical control measure at this stage is clearcutting well beyond the areas having red trees in order to remove trees containing beetles.

Natural Control

Resin flow and predation and parasitism are relatively ineffective in large infestations, but can be important in maintaining populations at endemic levels.

Resin flow is the tree's active defense mechanism against beetle invasion. It is effective in flushing out beetles (pitchout) or destroying eggs only when attack density is low, or when a high attack level is spread over a number of days. During periods of tree stress, such as drought, resin flow may be greatly reduced.

Predation and parasitism play a significant role in beetle population dynamics. Woodpeckers are the most conspicuous predators as they remove bark in search of beetle brood, in the process of

bark removal they also reduce the survival rate of the remaining insects due to desiccation. Perching birds also consume large quantities of flying beetles. Some of the more commonly encountered insect predators include the *clerid* (checkered) beetles, and *Diptera* (various true fly species). Several species of wasps occasionally kill large numbers of mountain pine beetles.

Temperature can be an important factor in determining population levels during the course of an infestation. Optimum under-the-bark temperatures for brood development are between 20 and 26°C. Cool summers may delay beetle flight and subsequently slow brood development, which can affect overwintering brood survival. Early fall temperatures of -18° will kill brood, while even less severe temperatures will kill eggs and larvae in the first three larval instars. The most cold-hardy stage, late-instar larvae, when conditioned for cold temperatures, cannot withstand temperatures below -37°; temperatures of -27° persisting for several days will kill a large portion of the population. Once the maturing larvae have resumed feeding in the spring they again become very susceptible to freezing temperatures. Since the impact of low temperatures is moderated by tree size, bark thickness and snow insulation, the duration of the cold period and snow pack is a critical factor to beetle survival.

Intraspecific competition affects brood production. High attack densities result in a more rapid rate of phloem desiccation; consequently, fewer adults emerge per unit area of bark surface. The adults which do emerge will also have a reduced capacity for egg production. Optimum attack densities appear to be between 3 and 10 per 1000 centimetres squared of lodgepole pine bark surface area, but it depends upon the thickness of phloem (food source). Food supply (phloem) is a main factor in regulating beetle populations. Beetles initially select larger diameter trees with thick phloem, in which populations can increase rapidly. As an infestation progresses and the larger diameter trees have already been killed, smaller trees with thinner phloem are attacked resulting in smaller broods. These trees will also dry out faster, leading to increased brood mortality. In general, when beetles attack trees under 25 centimetres in diameter, the number of progeny emerging will progressively become less with decreasing diameter.

Selected references

Amman, G.D.; McGregor, M.D.; Dolph, R.E. 1985. Mountain Pine Beetle. U.S. Dept. Agric., For. Serv. Pest Leaflet No. 2,11 p.

British Columbia Ministry of Forests. 1985. Protection Manual. Vol. II. Pest Management. Chap. 9. Major forest bark beetles, 74 p.

British Columbia Ministry of Forests and Lands. 1987. Mountain pine beetle, a menace to pine forests. PesTopics No. 24, 4 p.

Cole, W.E.; Amman, G.D. 1980. Mountain pine beetle dynamics in lodgepole pine forests. Part I: Course of an infestation. U.S. Dept. Agric., For. Serv. Gen. Tech. Rep. INT-89, 56p.

Cole, W.E.; Amman, G.D. 1983. Mountain pine beetle dynamics in lodgepole pine forests. Part II: Population dynamics. U.S. Dept. Agric., For. Serv. Tech. Rep. INT-145, 59 p.

McMullen, L.H.; Safranyik, L; Linton, D.A. 1986. Suppression of mountain pine beetle infestations in lodgepole pine forests. Can. For. Serv. Pac. For. Cent. Inf. Rep. BC-X-276, 20 p.

Moeck, H.A.; Safranyik, L. 1984. Assessment of predator and parasitoid control of bark beetles. Can. For. Serv. Pac. For. Cent. Inf. Rep. BC-X-248, 24 p.

Safranyik, L.; Shrimpton, D.M.; Whitney, H.S. 1974. Management of lodgepole pine to reduce losses from the mountain pine beetle. Environ. Can., Can. For. Serv., For. Tech. Rep. No.1, 24 p.

Shore, T.L.; Safranyik, L. 1992. Susceptibility and risk rating systems for mountain pine beetle in lodgepole pine stands. For. Can. Pac. For. Cent. Inf. Rep. BC-X-336,12 p.

Documents attached:

Appendix 4: Minister of Forests' letter of July 28, 1994

Appendix 5: Minister of Forests' memo of February 26, 1996

File: 10100-01

JUL 2 3 1994

John Cuthbert
Chief Forester
Ministry of Forests
595 Pandora Avenue
Victoria, British Columbia
V8W 3E7

Dear John Cuthbert:

Re: Economic and Social Objectives of the Crown

The *Forest Act* gives you the clear responsibility for determining Allowable Annual Cuts, decisions with far-reaching implications for the province's economy. The *Forest Act* provides that you consider the social and economic objectives of the Crown, as expressed by me, in making these determinations. The purpose of this letter is to provide this information to you.

The social and economic objectives expressed below should be considered in conjunction with environmental considerations as reflected in the Forest Practices Code, which requires recognition and better protection of non-timber values such as biodiversity, wildlife and water quality.

The government's general social and economic objectives for the forest sector are made clear in the goals of the Forest Renewal Program. In relation to the Allowable Annual Cut determinations you must make, I would emphasize the particular importance the government attaches to the continued availability of good forest jobs and to the long-term stability of communities that rely on forests.

Through the Forest Renewal Plan, the government is taking the steps necessary to facilitate the transition to more value-based management in the forest and the forest sector. We feel that adjustment costs should be minimized wherever possible, and to this end, any decreases in allowable cut at this time should be no larger than are necessary to avoid compromising long-run sustainability.

.../2

Province of
British Columbia

Minister of
Forests

Parliament Buildings
Victoria, British Columbia
V8V 1X4

In addition to the provincial perspective, you should also consider important local social and economic objectives that may be derived from the public input on the Timber Supply Review discussion papers where these are consistent with the government's broader objectives.

Finally, I would note that improving economic conditions may make it possible to harvest timber which has typically not been used in the past. For example, use of wood from commercial thinnings and previously uneconomic areas may assist in maintaining harvests without violating forest practices constraints. I urge you to consider all available vehicles, such as partitioned cuts, which could provide the forest industry with the opportunity and incentive to demonstrate their ability to utilize such timber resources.

Yours truly,

Andrew Petter
Minister

Province of British Columbia
OFFICE OF THE MINISTER

Ministry of Forests

MEMORANDUM

File: 16290-01

February 26, 1996

To: Larry Pedersen
Chief Forester

From: The Honourable Andrew Petter
Minister of Forests

Re: The Crown's Economic And Social Objectives Regarding Visual Resources

Further to my letter of July 29, 1994, to your predecessor, wherein I expressed the economic and social objectives of the Crown in accordance with Section 7 of the *Forest Act*, I would like to elaborate upon these objectives as they relate to visual resources.

British Columbia's scenic landscapes are a part of its heritage and a resource base underlying much of its tourism industry. They also provide timber supplies that are of significant economic and social importance to forest industry dependent communities.

Accordingly, one of the Crown's objectives is to ensure an appropriate balance within timber supply areas and tree farm licence areas between protecting visual resources and minimizing the impact of such protection measures on timber supplies.

As you know, I have directed that the policy on management of scenic landscapes should be modified in light of the beneficial effects of the Forest Practices Code. In general, the new policy should ensure that establishment and administration of visual quality objectives is less restrictive on timber harvesting. This change is possible because alternative harvesting approaches as well as overall improvement in forest practices will result in reduced detrimental impacts on visually sensitive areas. Also, I anticipate that the Forest Practices Code will lead to a greater public awareness that forest harvesting is being conducted in a responsible, environmentally sound manner, and therefore to a decreased public reaction to its visible effects on the landscape. In relation to the Allowable Annual Cuts determinations that you make, please consider the effects that the new policy will have in each Timber Supply Area and Tree Farm Licence.

.../2

In keeping with my earlier letter, I would re-emphasize the Crown's objectives to ensure community stability and minimize adjustment costs as the forest sector moves to more value-based management. I believe that the appropriate balance between timber and visual resources will be achieved if decisions are made consistent with the ministry's February 1996 report *The Forest Practices Code: Timber Supply Analysis*.

Finally, in my previous letter I had asked that local economic and social objectives be considered. Please ensure that local views on the balance between timber and visual resources are taken into account within the context of government's broader objectives.

Andrew Petter
Minister of Forests